

WHAT IS CLAIMED IS:

1. A method for operating a path network for carrying out communications between nodes using one or more working paths and one or more protection paths, the method comprising the steps of:

transmitting path signals from a transmitting node to a receiving node through the working paths and the protection paths; and

- 10 converting a protection path into a working path temporarily in order to increase a bandwidth of the working paths when a bandwidth increase request occurs in the path network.

- 15 2. The method of claim 1, wherein at the transmitting step, the transmitting node transmits the path signals obtained by attaching a path overhead to client signals, where the path overhead contains an automatic path conversion information to be used in converting a protection path into a working path, and

20 at the converting step, the transmitting node and the receiving node convert a protection path into a working path by using the automatic path conversion information contained in the path overhead.

- 25 3. The method of claim 2, wherein the converting step further comprises the steps of:

30 at the transmitting node, transmitting the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion request for requesting a conversion of a protection path into a working path to the receiving node;

35 at the receiving node, in response to the protection path conversion request, reserving an output terminal at a receiving side, connecting an input of the output terminal

to a path from which the protection path conversion request is received, and returning the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion reverse request for requesting transmission of signals through a converted path to the transmitting node; and

at the transmitting node, in response to the protection path conversion reverse request, transmitting the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion complete notice to the receiving node, through the converted path.

4. The method of claim 1, further comprising the steps of:

adding protection paths in order to increase a bandwidth of the protection paths after the converting step; and

re-arranging the working paths and the protection paths after the adding step such that all the working paths connect the transmitting node and the receiving node via a first route and all the protection paths connect the transmitting node and the receiving node via a second route.

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5. The method of claim 4, further comprising the step of: assigning priority orders among the working paths and the protection paths in advance, such that the converting step converts a protection path with a highest priority order into a working path;

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wherein the re-arranging step re-arranges the working paths and the protection paths by re-assigning the priority orders among the working paths and the protection paths.

35 6. The method of claim 5, wherein at the transmitting

step, the transmitting node transmits the path signals obtained by attaching a path overhead to client signals, through each one of the working paths and the protection paths, where the path overhead attached to the path signals to be transmitted through each path contains a priority order information indicating a priority order of each path, and

at the converting step, the transmitting node and the receiving node convert a protection path into a working path by using the priority order information contained in the path overhead attached to the path signals transmitted through each path.

7. The method of claim 1, further comprising the step of: releasing a part of the working paths and the protection paths in order to reduce a bandwidth of the working paths and the protection paths when a required bandwidth in the path network decreases.

8. A path network for carrying out communications between nodes, comprising:

a transmitting node for transmitting path signals;
a receiving node for receiving the path signals; and
one or more working paths and one or more protection paths for transmitting path signals between the transmitting node and the receiving node;

wherein the transmitting node and the receiving node have a function for converting a protection path into a working path temporarily in order to increase a bandwidth of the working paths when a bandwidth increase request occurs in the path network.

9. The path network of claim 8, wherein the transmitting node has path generation units for transmitting the path signals obtained by attaching a path overhead to client

signals, where the path overhead contains an automatic path conversion information to be used in converting a protection path into a working path, and the receiving node has path termination units for applying a termination
5 processing to the path overhead, such that the path generation units and the path termination units convert a protection path into a working path by using the automatic path conversion information contained in the path overhead.

10 10. The path network of claim 9, wherein the transmitting node has path generation units for transmitting the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion request for requesting a conversion of a
15 protection path into a working path to the receiving node;
the receiving node has path termination units for reserving an output terminal at a receiving side, connecting an input of the output terminal to a path from which the protection path conversion request is received,
20 and returning the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion reverse request for requesting transmission of signals through a converted path to the transmitting node, in response to the protection
25 path conversion request; and

the path generation units of the transmitting node also transmit the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion complete notice to
30 the receiving node, through the converted path, in response to the protection path conversion reverse request.

11. The path network of claim 8, further comprising:
a network management system for adding protection
35 paths in order to increase a bandwidth of the protection

paths after a conversion of a protection path into a working path, and re-arranging the working paths and the protection paths after an addition of the protection paths such that all the working paths connect the transmitting node and the receiving node via a first route and all the protection paths connect the transmitting node and the receiving node via a second route.

12. The path network of claim 11, wherein the network management system also assigns priority orders among the working paths and the protection paths in advance, such that the transmitting node and the receiving node convert a protection path with a highest priority order into a working path, and re-arranges the working paths and the protection paths by re-assigning the priority orders among the working paths and the protection paths.

13. The path network of claim 12, wherein the transmitting node has path generation units for transmitting the path signals obtained by attaching a path overhead to client signals, through each one of the working paths and the protection paths, where the path overhead attached to the path signals to be transmitted through each path contains a priority order information indicating a priority order of each path, and the receiving node has path termination units for applying a termination processing to the path overhead, such that the path generation units and the path termination units convert a protection path into a working path by using the priority order information contained in the path overhead attached to the path signals transmitted through each path.

14. The path network of claim 8, wherein the transmitting node and the receiving node also have a function for releasing a part of the working paths and the protection

paths in order to reduce a bandwidth of the working paths and the protection paths when a required bandwidth in the path network decreases.

- 5 15. A node device functioning as a transmitting node in a path network for carrying out communications between nodes using one or more working paths and one or more protection paths, the node device comprising:

10 a plurality of path generation units, each path generation unit transmits path signals obtained by attaching a path overhead to client signals, where the path overhead contains an automatic path conversion information to be used in converting a protection path into a working path, such that a protection path is converted into a
15 working path temporarily by using the automatic path conversion information contained in the path overhead, in order to increase a bandwidth of the working paths when a bandwidth increase request occurs in the path network;

20 a plurality of multiplexing units, each multiplexing unit multiplexes the path signals to be transmitted through each route and transmits multiplexed path signals through each route; and

25 a switch unit for switching the path signals transmitted by the path generation units into the multiplexing units.

- 30 16. The node device of claim 15, wherein at a time of converting a protection path into a working path, the path generation units transmit the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion request for requesting a conversion of a protection path into a working path to the receiving node, and when the transmission node receives the path signals with the path
35 overhead that contains the automatic path conversion

information indicating a protection path conversion reverse request for requesting transmission of signals through a converted path to the transmitting node, that is returned from the receiving node in response to the protection path conversion request, the path generation units transmit the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion complete notice to the receiving node, through the converted path, in response to the protection path conversion reverse request.

17. The node device of claim 15, wherein each path generation unit attaches the path overhead that also contains a priority order information indicating a priority order of each path to the path signals to be transmitted through each path, such that the transmitting node and the receiving node convert a protection path into a working path by using the priority order information contained in the path overhead attached to the path signals transmitted through each path.

18. A node device functioning as a receiving node in a path network for carrying out communications between nodes using one or more working paths and one or more protection paths, the node device comprising:

a plurality of path termination units, each path termination unit applies a termination processing to a path overhead attached to path signals received from a transmitting node, where the path overhead contains an automatic path conversion information to be used in converting a protection path into a working path, such that a protection path is converted into a working path temporarily by using the automatic path conversion information contained in the path overhead, in order to increase a bandwidth of the working paths when a bandwidth

increase request occurs in the path network;

a plurality of demultiplexing units, each demultiplexing unit demultiplexes multiplexed path signals transmitted through each route into path signals for each

5 path; and

a switch unit for switching the path signals for each path obtained by the demultiplexing units into the path termination units.

10 19. The path network of claim 18, wherein at a time of converting a protection path into a working path, when the receiving node receives the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion request
15 for requesting a conversion of a protection path into a working path from the transmitting node, the path termination units reserve an output terminal at a receiving side, connect an input of the output terminal to a path from which the protection path conversion request is
20 received, and return the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion reverse request for requesting transmission of signals through a converted path to the transmitting node, in response to the
25 protection path conversion request, and receive the path signals with the path overhead that contains the automatic path conversion information indicating a protection path conversion complete notice from the transmitting node, through the converted path, in response to the protection
30 path conversion reverse request.

20. The node device of claim 18, wherein each path termination unit applies the termination processing to the path overhead attached to the path signals for each path
35 that also contains a priority order information indicating

a priority order of each path, such that the transmitting node and the receiving node convert a protection path into a working path by using the priority order information contained in the path overhead attached to the path signals
5 transmitted through each path.

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